INITIATOR AND GAS GENERATOR

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an initiator suitably incorporated in a gas generator in an air bag device, a seat-belt pretensioner, and the like, and to a gas generator having the initiator.

[0002] In air bag devices provided in high-speed moving bodies such as automobiles, an air bag is quickly inflated by a gas generator called an inflator. The gas generator contains a gas-generating agent, and an initiator for causing the gas-generating agent to start a gas-generating reaction. Conventionally, the initiator includes a reactant, and a filament-shaped bridge wire serving as a heating resistor that causes the reactant to start a reaction, as described in Japanese Unexamined Patent Application Publication No. 2000-292099, and U.S. Patent No. 5,404,263 (both incorporated by reference). A connector-retaining portion is provided in the rear of the initiator to retain a connector for the application of electricity as described in Japanese Unexamined Patent Application Publication No. 2001-165600 (incorporated by reference).

[0003] An example of a known initiator will be described with reference to Fig. 3.

[0004] An initiator 10 includes a substantially cylindrical cup 12 having a closed end and an open rear end. A reactant 14 is contained in the cup 12. The rear of the cup 12 is closed by a header 16. The leading end of an electrode pin 18 extending through the header 16 lies inside the cup 12.

[0005] A bridge wire 22 is provided between the leading end of the electrode pin 18 and the header 16. Both ends of the bridge wire 22

are welded, respectively, to the electrode pin 18 and the header 16. The bridge wire 22 is in contact with the reactant 14 inside the cup 12.

[0006] The electrode pin 18 and the header 16 are spaced with an insulating material 19, such as glass, therebetween so as not to be in electric contact with each other.

[0007] An electrode pin (ground pin) 20 protrudes from the header 16. A resin mold 24 is formed to surround the header 16 and the bottoms of the electrode pins 18 and 20, and a substantially annular collar 26 is combined with the resin mold 24.

[0008] The collar 26 has a hole 32 in which a connector 30 is to be inserted. A retaining recess 34 is provided on an inner peripheral surface at the entrance of the hole 32 so as to retain the connector 30. A retaining projection 36 is provided on a side face of the connector 30 so as to engage with the retaining recess 34. Pin jacks 18j and 20j in which the electrode pins 18 and 20 are to be inserted are provided on a leading end face of the connector 30. In order to cause the connector 30 to point in one direction, the resin mold 24 has a D-shaped projection 24D, and a D-shaped recess 30D in which the projection 24D is to be fitted is provided on the leading end face of the connector 30. The projection 24D and the recess 30D are sometimes T— shaped, instead of being D-shaped.

[0009] In an emergency such as a car collision, a voltage is applied from a battery to the bridge wire 22 through the electrodes 18 and 20. In response thereto, the bridge wire 22 generates heat, and the reactant 14 is ignited to start a reaction. High-pressure gas and heat are generated by the reaction of the reactant 14, and a gas-generating agent in a gas generator causes a gas-generating reaction. With the reaction, the cup 12 is broken, and hot gas or the like is emitted.

[0010] For example, the reactant includes a first reactant composed of a mixture of lead styphnate and aluminum powder disposed

to surround the bridge wire 22, and a second reactant composed of BKNO3 or gunpowder disposed to surround the first reactant. The first reactant rapidly reacts to generate heat, and the second reactant starts to react in response to the heat from the first reactant, thereby producing high-pressure hot gas and fine particles.

[0011] Since the above-described known initiator 10 has two pins, it needs to be mounted in an initiator housing so that the rotation angles of the initiator housing and the initiator precisely coincide with each other, and this makes mounting operation difficult.

[0012] For such a reason, the production cost of the known initiator is mostly high.

[0013] Furthermore, the two electrode pins 18 and 20 are arranged side by side with a predetermined distance therebetween, the width of the connector 30 is large.

SUMMARY OF THE INVENTION

[0014] An object of the present invention is to overcome the above problems, and to provide an initiator that can be easily produced at a low production cost and that can reduce the size of a connector, and a gas generator using the initiator.

[0015] An initiator of the present invention includes a conductive header, a reactant disposed on one side of the header, a cover member for covering the reactant, an electrode pin extending through the header to protrude from the other side of the header, and insulated from the header, a heating member provided between the one side of the header and the electrode pin so as to generate heat by the application of electricity, a cylindrical terminal protruding from the other side of the header coaxially with the electrode pin, and a connector-retaining portion provided at a leading end of the cylindrical terminal.

[0016] In such an initiator, since the electrode pin and the cylindrical terminal are coaxial, the initiator can be mounted in an initiator housing in whatever direction it points, and the efficiency in mounting the initiator in the initiator housing is high.

[0017] Since the electrode pin and the cylindrical terminal are coaxially arranged, the size of the connector can be reduced.

[0018] At the connector-retaining portion, an outward flange may be provided at the leading end of the cylindrical terminal. This structure is simple and is easily formed.

[0019] An initiator of another embodiment of the present invention includes a conductive header, a reactant disposed on one side of the header, a cover member for covering the reactant, an electrode pin extending through the header to protrude from the other side of the header, and insulated from the header, a heating member provided between the one side of the header and the electrode pin so as to generate heat by the application of electricity, and a connector-retaining portion provided at a leading end of the electrode pin.

[0020] Since the initiator has only one electrode pin, it can be mounted in an initiator housing in whatever direction the connector points, and the efficiency in mounting the initiator in the initiator housing is high. Moreover, the size of the connector can be reduced.

[0021] In a case in which the connector-retaining portion is shaped like a cone that decreases in diameter toward its leading end, the structure is simple and is easily formed.

[0022] In the present invention, a bridge wire is suitable as the heating member for generating heat by the application of electricity. The bridge wire is inexpensive, and the initiator can be produced easily. However, the heating member is not limited to the bridge wire.

[0023] A gas generator of the present invention includes a gas-generating agent, and the above initiator of the present invention that causes the gas-generating agent to start a gas-generating reaction.

[0024] The present invention provides an initiator that can be easily produced at a low production cost and that can reduce the size of a connector, and a gas generator using the initiator.

[0025] It is to be understood that both the foregoing general description and the following detailed description are exemplary and exemplary only, and are not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] These and other features, aspects, and advantages of the present invention will become apparent from the following description, appended claims, and the accompanying exemplary embodiments shown in the drawings, which are briefly described below.

[0027] Fig. 1 is a cross-sectional view of an initiator.

[0028] Fig. 2 is a cross-sectional view of an initiator according to another embodiment of the present invention.

[0029] Fig. 3 is a cross-sectional view of a known initiator.

DETAILED DESCRIPTION

[0030] Embodiments of the present invention will be described below with reference to the drawings. Figs. 1 and 2 are cross-sectional views of initiators according to the embodiments of the present invention.

[0031] In an initiator 50 shown in Fig. 1, a cup 52 and a header 54 fitted in an entrance of the cup 52 constitute a casing 56. The casing 56 is filled with a reactant 58. In this embodiment, the cup 52 is shaped like a circular container made of SUS304 or the like. A body of the header 54 is shaped like a disc made of an anticorrosion metal such as

SUS304, and an outer peripheral surface thereof is fixed to an inner peripheral surface of the cup 52, for example, by welding.

[0032] A cylindrical terminal 54A protrudes from the center of an outer surface of the disc-shaped body of the header 54. A connector-retaining portion 54a shaped like an outward flange (thick flange) is provided at the leading end of the cylindrical terminal 54A. The cylindrical terminal 54A is formed integrally with the disc-shaped body of the header 54.

[0033] A hole 60 extends from a leading end face of the cylindrical terminal 54A to an inward surface of the header 54 (surface facing the interior of the casing 56)

[0034] An electrode pin 62 coaxially extends through the hole 60. The electrode pin 62 is fixed to the header 54 with an insulating fixing material 66, such as glass, therebetween so as not to touch the header 54. The leading end of the pin 62 protrudes outward from the cylindrical terminal 54A. Inside the casing 56, a bridge wire 68 is provided between the surface of the header 54 inside the cup 52, and an end face of the electrode pin 62.

[0035] An outer surface of the cup 52 is covered with a resin cover 52a made of nylon, polypropylene, or the like. A rear side of the cup 52 and a rear end face of the header 54 are covered with a resin mold 70 made of nylon, polybutylene terephthalate, or the like. The cylindrical terminal 54A extends outward through the resin cover 70. A ground terminal of a connector contacts the leading end of the cylindrical terminal 54A.

[0036] A reactant 58 is contained in a casing 56 of an initiator 50. An electrode pin 62 is fitted in a hole 66 of a header 54 and is fixed by glass or the like. A bridge wire 68 is provided between the electrode pin 62 and the header 54. A cylindrical terminal 54A protrudes from the header 54, and the electrode pin 62 extends through the cylindrical

terminal 54A. A connector-retaining portion 54a is provided at the leading end of the cylindrical terminal 54A.

[0037] The reactant 58 may be composed of only a first reactant (ignition agent) , or may be composed of a mixture of the first reactant and a second reactant (oxidizer particles). Although not particularly limited, the first reactant includes, for example, a single metal, such as Mg, Zr, Ti, W, B, Si, C, Be, Li, Al, V, CaC_2, Ca, Ce, or La, or an alloy or compound of them. Although not particularly limited, the second reactant includes, for example, $KC1O_4$, $KCLO_3$, Kb_4, NH_4C1O_4, NH_4NO_3, KNO_3, Fe_2O_3, Fe_3O_4, $Sr(NO_3)_2$, CuO, or NiO.

[0038] A connector (not shown in Fig. 1) is attached to the initiator 50 from the upper side of Fig. 1. The connector has a pin jack in which the electrode pin 62 is to be inserted, and a hole in which the cylindrical terminal 54A is to be inserted. A chuck portion is provided on an inner surface of the hole to engage with the connector-retaining portion 54a. When the cylindrical terminal 54A is inserted in the hole to a predetermined depth, the chuck portion is retained by the connector-retaining portion 54a, thereby preventing the connector from falling off.

[0039] In the initiator 50 having such a configuration, when a voltage is applied between the electrode pin 62 and the cylindrical terminal 54A, the bridge wire 68 generates heat, the reactant 58 starts to react, and a high-pressure and hot gas containing fine particles is generated. In a case in which the reactant 58 contains oxidizer particles, the reaction is accelerated because metal particles quickly causes an oxidation reaction and generates heat by an oxidizing action of the oxidizer particles.

[0040] In the initiator 50, since the electrode pin 62 and the cylindrical terminal 54A are coaxial, the connector can be fitted on the cylindrical terminal 54A in whatever direction around the pin jack it points. Moreover, since the electrode pin 62 and the cylindrical terminal

54A are coaxial, the connector may be small. In addition, the initiator 50 can be produced easily.

[0041] In an initiator 80 shown in Fig. 2, a cup 82 and a header 84 fitted in an entrance of the cup 82 constitute a casing 86. The casing 86 is filled with a reactant 88. In this embodiment, the cup 82 is shaped like a circular container made of $SUS_3 3O_4$ or the like. The header 84 is a substantially cylindrical member made of $SUS_3 3O_4$ or the like, and having a small-diameter portion 84a and a large-diameter portion 84b. An outer peripheral surface of the small-diameter portion 84a is fixed to an inner peripheral surface of the cup 82, for example, by welding.

[0042] A hole 90 is provided in the center of the header 84 to extend therethrough in the axial direction of the cylinder.

[0043] An electrode pin 92 extends through the hole 90. The pin 92 is fixed to the header 84 with an insulating fixing material 96, such as glass, therebetween so as not to touch the header 84. The leading end of the pin 92 protrudes outward from the header 84.

[0044] A frusto-conical connector-retaining portion 92a that tapers off toward the leading end is provided integrally with the leading end of the electrode pin 92. The base end of the connector-retaining portion 92a has a diameter larger than the diameter of the electrode pin 92.

[0045] A bridge wire 98 is provided between an end face of the header 84 inside the cup 82, and an end face of the electrode pin 92.

[0046] An outer surface of the cup 82 is covered with a resin cover 82a made of nylon, polypropylene, or the like. A rear side of the cup 82 and a rear end face of the header 84 are covered with a resin mold 100 made of nylon, polybutylene terephthalate, or the like. Almost the center of an outer end face of the header 84 is not covered with the resin mold 100. A ground terminal of a connector contacts the exposed face of the header 84.

[0047] A connector (not shown) is attached to the initiator 80 from the upper side in Fig. 2. The connector has a pin jack in which the electrode pin 92 is to be inserted. A chuck portion is provided in the innermost portion of the pin jack to engage with the connector-retaining portion 92a. When the electrode pin 92 is inserted in the pin jack to a predetermined depth, the chuck portion engages with the connector-retaining portion 92a, thereby preventing the connector from falling off.

[0048] In the initiator 80 having such a configuration, when a voltage is applied between the electrode pin 92 and the header 84, the bridge wire 98 generates heat, the reactant 88 starts to react, and a high—pressure hot gas containing fine particles is generated.

[0049] In the initiator 80 shown in Fig. 2, only one electrode pin 92 protrudes from the header 84, and the connector can be attached to the initiator 80 in whatever direction around the electrode pin 92 it points. Moreover, the connector may be small. In addition, the initiator 80 can be produced easily.

[0050] The initiator of the present invention is applicable to various gas generators. The gas generators may be incorporated in various air bag devices, such as a driver's seat air bag, a passenger's seat air bag, a rear-seat air bag, a side air bag, a head-protection air bag, and a pedestrian-protection air bag, and in seat-belt pretensioners.

[0051] The priority applications, Japanese Patent Application No. 2003-12497, filed on January 21, 2003 and Japanese Patent Application No. 2003-296486, filed on August 20, 2003, including the specification, drawings, claims and abstract, are incorporated herein by reference in their entirety.

[0052] Given the disclosure of the present invention, one versed in the art would appreciate that there may be other embodiments and modifications within the scope and spirit of the invention. Accordingly, all modifications attainable by one versed in the art from the present

disclosure within the scope and spirit of the present invention are to be included as further embodiments of the present invention. The scope of the present invention is to be defined as set forth in the following claims.